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Modelling of the plasma environment surrounding 67P: the effect of the convective electric field on ion density profiles

Arnaud Beth, Marina Galand, and Steven J. Schwartz
Imperial College London, Department of Physics / SPAT, London, United Kingdom

By following comet 67P/Churyumov-Gerasimenko along its orbit, Rosetta during its cruise is offering us the unique opportunity to understand the complex evolution of the comet with its environment. Although the coma is not bound at the surface, its photo-ionisation by solar extreme ultraviolet radiation creates a complex plasma environment which interacts with and is influenced by the solar wind. We consider the critical role played by collisionless processes (e.g. the effect of external electric and magnetic fields) in shaping the resulting ionospheric density profiles.

In particular, the photo-ionisation of sublimated water molecules leads to the production of H_2O^+. These new ions are subjected to the electromagnetic environment of the solar wind in which they are born. In particular, the convective electric field $\vec{E}_{conv}$ associated with the component of the solar wind flow perpendicular to the interplanetary magnetic field (i.e. $\vec{E}_{conv} \approx -\vec{v}_{SW} \wedge \vec{B}$) will strongly influence the dynamics of new ions and electrons and thus their density profiles around the comet. To lowest order that field can be described by the generalized Ohm's law of MHD. However, the small scales associated with 67P must be taken into consideration.

We show that the convective electric field plays a key-role in the distribution of ions in the vicinity of the comet and in their transport. In particular, the physical size of the comet should be considered and the comet should not be reduced to a point source in the model. Finally, we will discuss the establishment of an induced ambipolar electric field on the ionospheric plasma to counteract the effect of $\vec{E}_{conv}$.